Sb-Stabilized GaAs(001) Surfaces*

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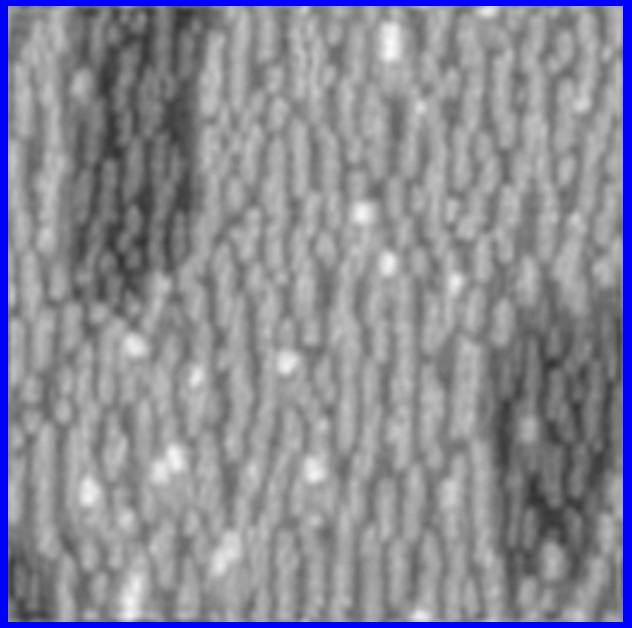
Sb on GaAs(001)-(2×4): Background

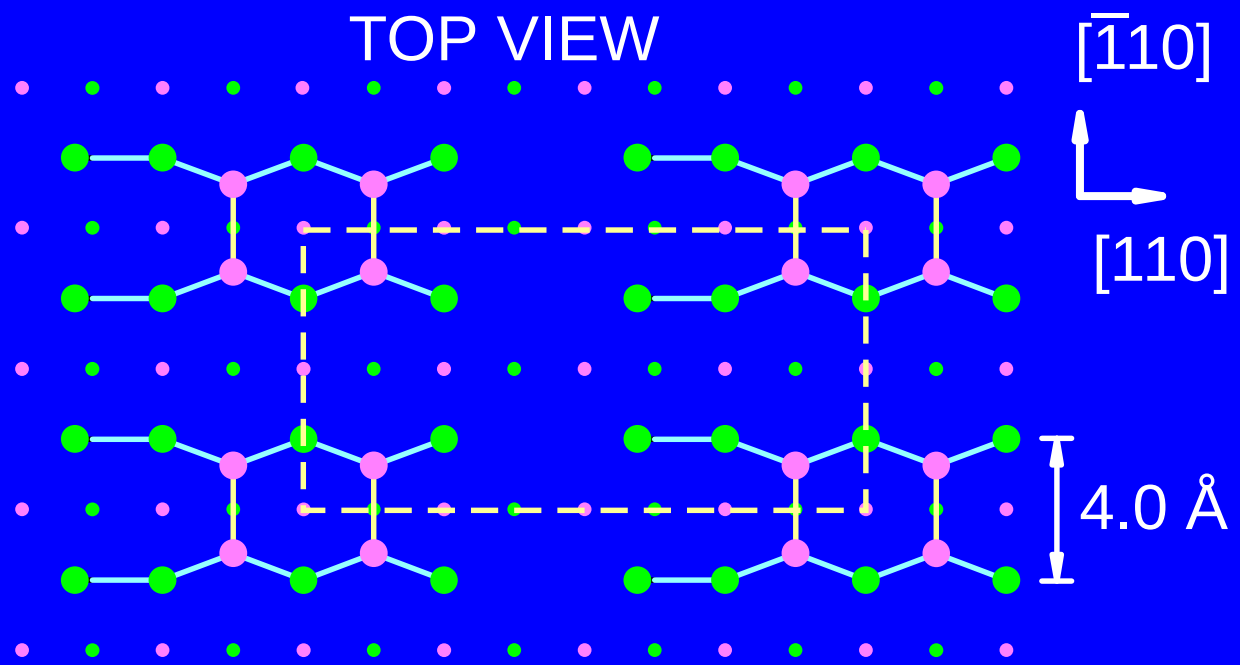
- GaSb, AlSb, InSb/GaAs for novel superlattice, quantum well electronics
  - Structure of interfaces?
- Starting surface for III-Sb Quantum Dots/GaAs
  - See B. Bennett (N25.04) later
- Two reconstructions reported: 2×8, 2×4
  - One STM study and one theory study of 2×4

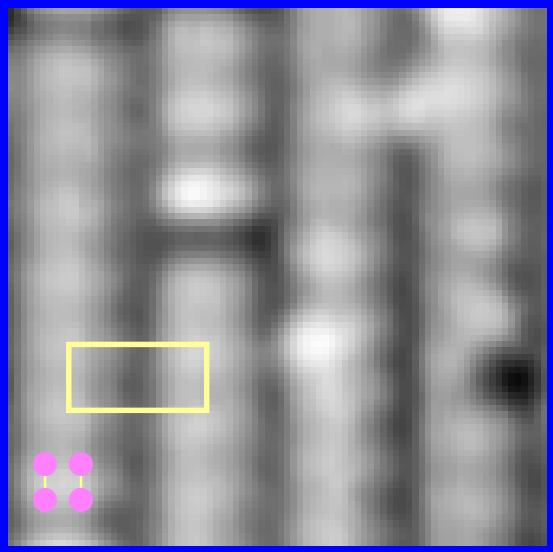
800 Å × 800 Å



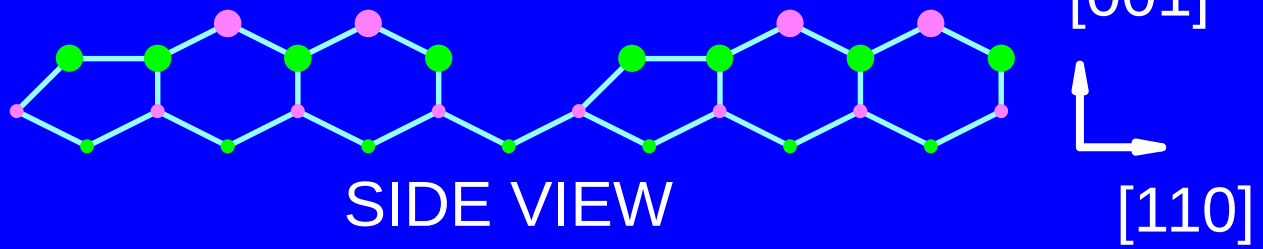
1.5 ML InSb on GaAs(001)-(2×4)

GaAs(001)-(2x4)





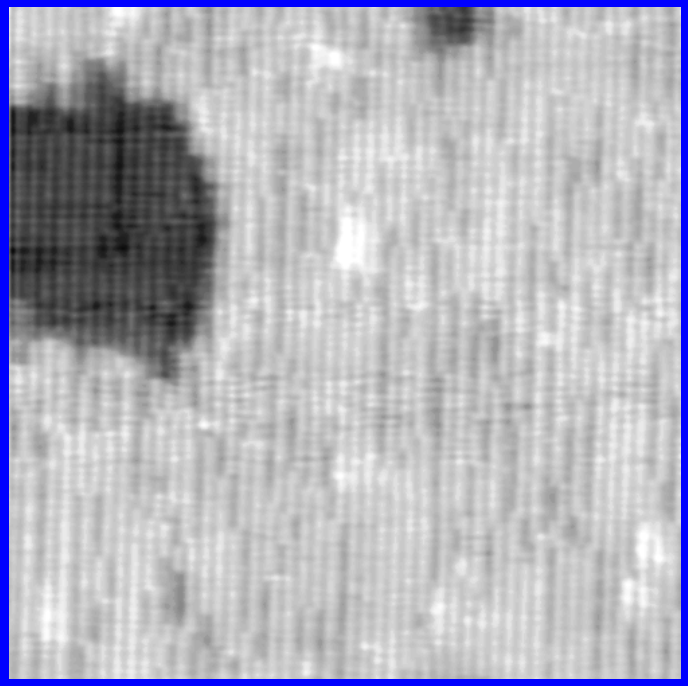
- 1st layer As
- 2nd layer Ga
- 3rd layer As
- 4th layer Ga



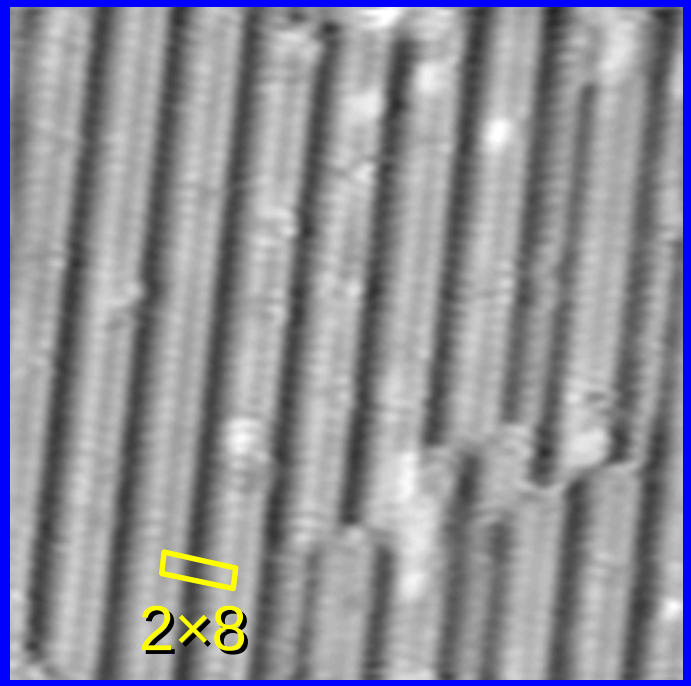
Sb:GaAs(001)-(2×8)

- Expose GaAs(001)-(2×4) at 530 °C to Sb_4
- First reported by Ludeke in '77

1500 Å × 1500 Å



290 Å × 290 Å

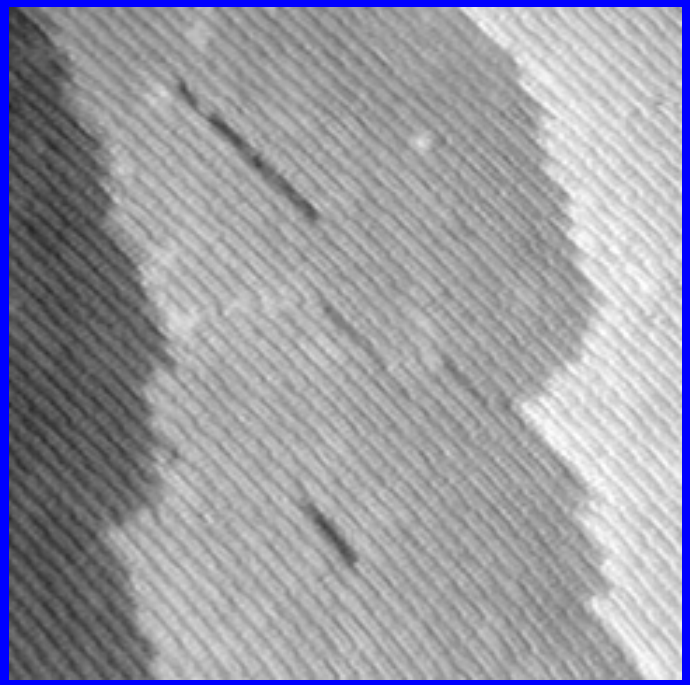


Filled states (2.5 V)

Sb:GaAs(001)-(2×4)

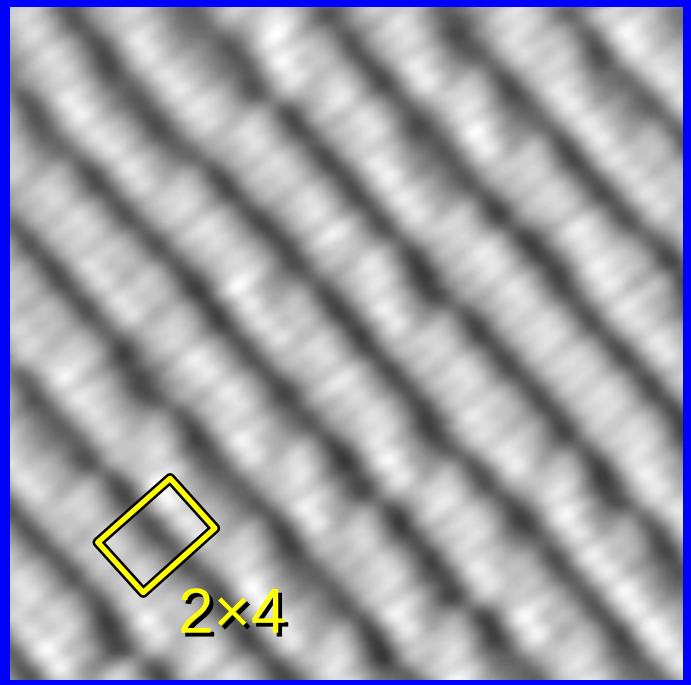
- Heat Sb:GaAs(001)-(2×8) to 460 °C
- XPS => ~ half the Sb as on (2×8)

700 Å × 700 Å



$[\bar{1}10]$

120 Å × 120 Å

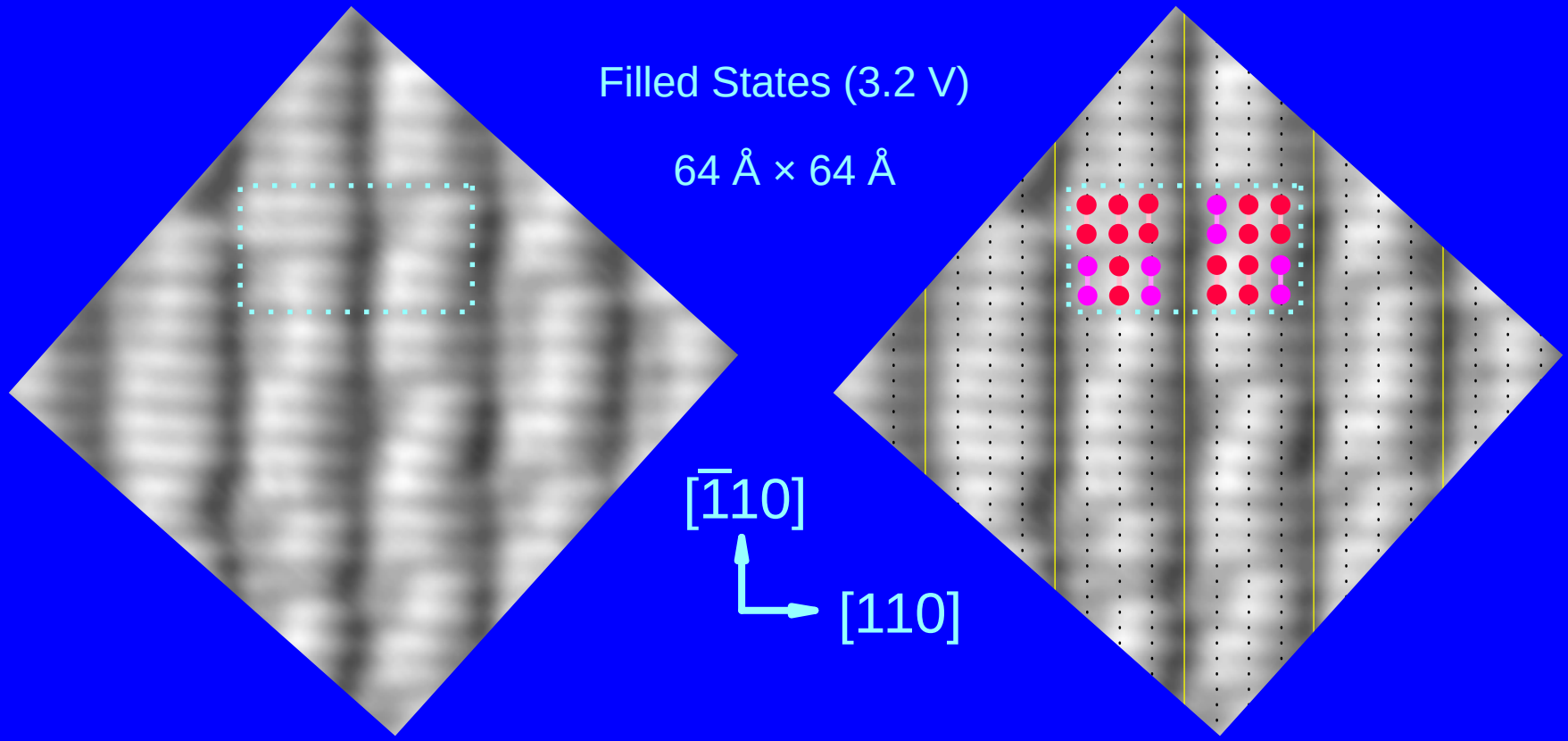


Filled states (3.0 V)

- Images similar to Moriarty *et al.* (PRB 6/15/96)

Sb:GaAs(001)-(2×4): Atomic Resolution

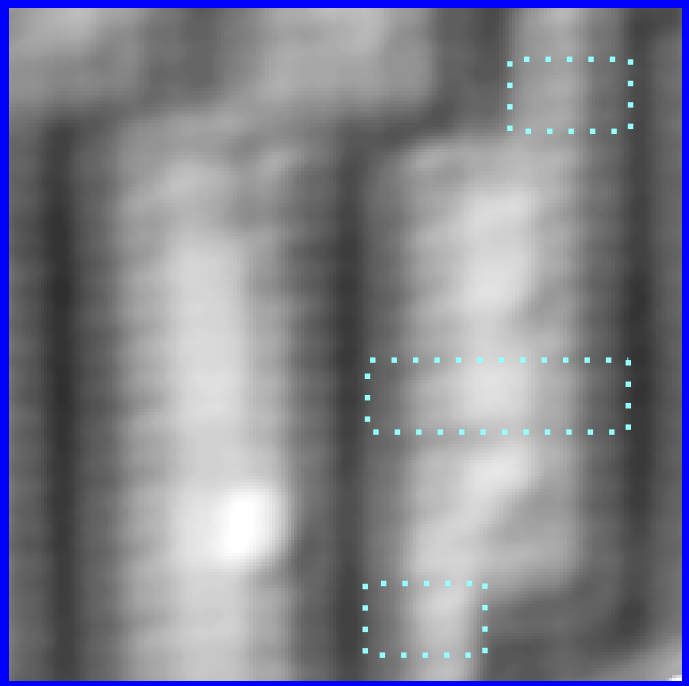
- Looks like mixture of Sb and As dimers
- ~2/3 dimers bright (~1 Å; Sb?), 1/3 dim (As?)



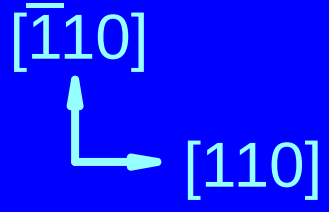
Sb:GaAs(001)-(2×8): Atomic Resolution

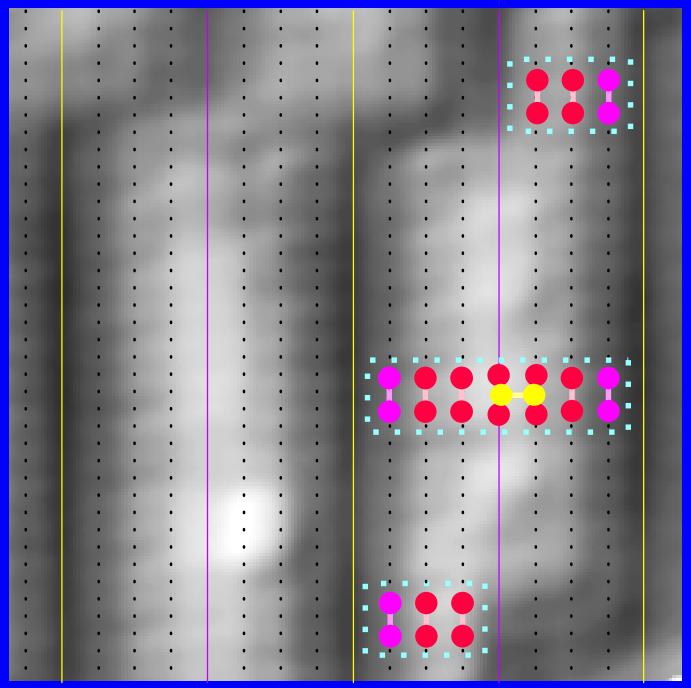
- Complicated, bias-dependent structure
- Asymmetrical across [$\bar{1}$10] (occurs both ways)

72 Å × 72 Å

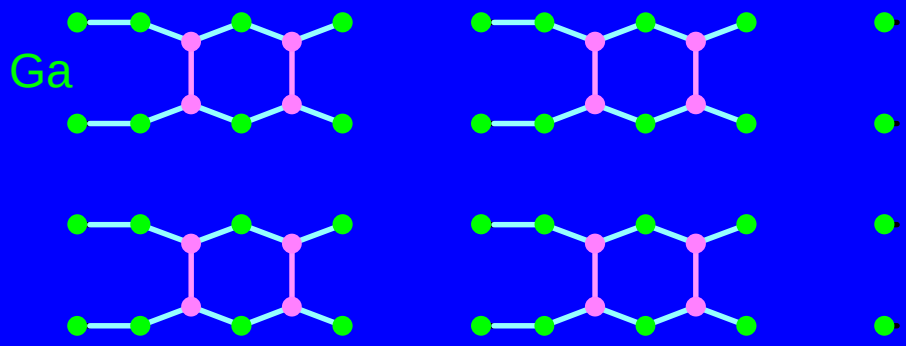


Filled States (2.8 V)





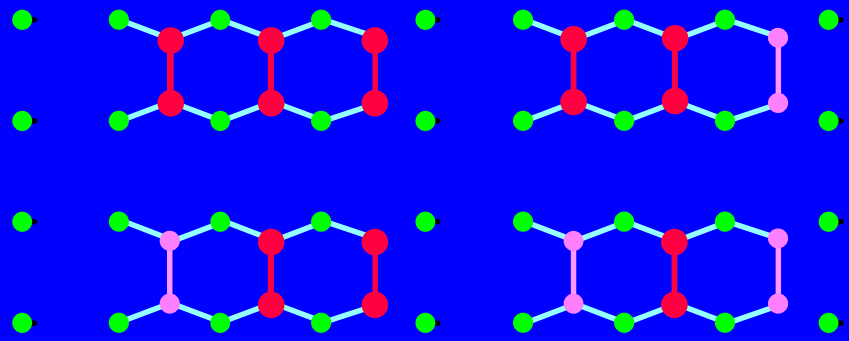
Possible Structures of Sb:GaAs(001)



Clean (2×4)

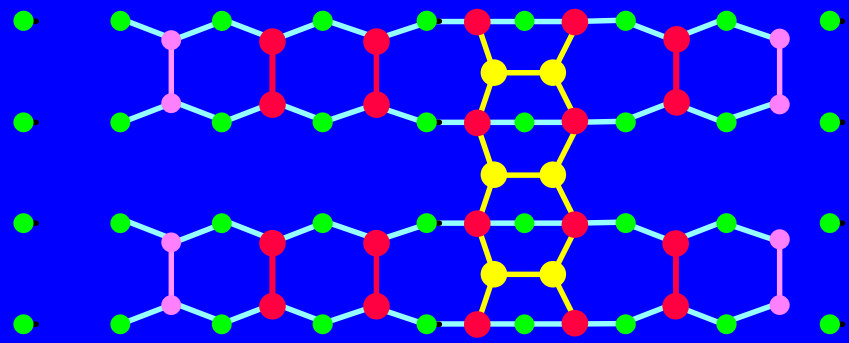
● As (ML) ● Sb (ML)

0.5 0.0



Sb-(2×4)

0.25 0.5



Sb-(2×8)

0.25 0.875

Sb-Stabilized GaAs(001) Surfaces

- Atomic-res. filled-state images of (2×4), (2×8)
  - Considerable bias-dependence
  - Need empty state images
  - Reconstructions appear to have both Sb and As dimers
- Proposed models consistent w/ images, XPS
- Need calibrated XPS, theoretical calculations